Regional Plan Association NJ CT NY

THE FAR WEST SIDE: TRANSPORTATION NEEDS AND IMPACTS

A Report by Regional Plan Association in preparation for the 14th Annual Regional Assembly

March 2004

foreword

This paper is the second in a series of reports that Regional Plan Association will prepare as background for its 14th annual Regional Assembly, to be held on April 16, 2004. The City of New York has put forward an ambitious and comprehensive plan for developing the Far West Side that recognizes the potential of this part of the city. With this in mind, we've named this year's Regional Assembly "Make No Small Plans" and dedicated it to a discussion of plans for the Far West Side and their impact on the Region's future. The Assembly will bring together leaders from the public, private and academic sectors for the first comprehensive forum on this vital issue.

To best inform the discussion in April, these reports will provide background research on areas critical to determining how development on the Far West Side can be most successful and beneficial from a regional perspective. The first report, released in February, looked at the current and future markets for office and residential development in the region. It is available at www.rpa.org. This paper addresses the transportation issues and implications connected to development on the Far West Side. We examine how people would and should get to and from the new district, and what impact these trips will have on the Region's transportation system as whole. The third and final paper will address the role that urban design and amenities play in creating vibrant, 21st Century mixed-use districts.

We applaud the City of New York for its ambitious and visionary planning efforts both on the Far West Side and throughout the City, and look forward to a productive public debate that will culminate at the Regional Assembly in April.

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Regional Plan Association improves the quality of life and the economic competitiveness of the New York-New Jersey-Connecticut region through research, planning, and advocacy. For more than 80 years, RPA has been shaping transportation systems, protecting open spaces, and promoting better community design for the region's continued growth. We anticipate the challenges the region will face in the years to come, and we mobilize the region's civic, business, and government sectors to take action.

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I. Summary of Findings and Conclusions

There is broad agreement that transportation investments are the key to developing the Far West Side (FWS) of midtown Manhattan. New York City's plans to redevelop the area roughly bounded by Eighth Avenue, 42nd Street, 30th Street and the Hudson River includes $5 billion in proposed public investments, with approximately $2 billion earmarked for an extension of the #7 Flushing subway line. However, other transit options, including buses, ferries, commuter rail service and light rail, could also be important parts of a comprehensive transportation strategy for the district.

There is less appreciation that the realization of this plan, or even a substantial portion of it, would have major implications for the entire transportation network that serves the Manhattan Central Business District. Much of this network—subway lines, commuter railroads, transportation hubs, auto crossings and streets—is at or near capacity. With the potential for over 100,000 new office workers, 25,000 new residents and increases in visitors, tourists and shoppers, development on the Far West Side will put additional strains on this system with more people entering Manhattan from all directions.

Therefore, analysis of the transportation implications for the Far West Side must not be limited to the capacity improvements needed to reach the district, but must also include an assessment of the how the district will affect capacity and mobility throughout the system. Because the pace and mix of development on the Far West Side (FWS) is uncertain, this report posits a number of development scenarios and tests how well a variety of proposed transportation projects, either in isolation or in combination would meet the travel demand generated by each scenario and the burden it would impose on the transportation system.

The report examines six development scenarios for the Far West Side. The first is the City's proposal for 28 million square feet (msf) of office development and 12,000 new housing units, with office development coming on line at a rate of roughly one million square feet per year from 2010-2040. The other five have either more housing (20,000 units), less office development (21 msf or 14 msf), or a later start to office development (first construction beginning after 2020) than the City's proposal.

Because of its central role in delivering people to the Far West Side as a catalyst to development there, special attention is given to analyzing how well the Flushing line extension to the Far West Side would be used and what impacts it may have on the subway system. To determine the extent to which the Flushing line is likely to be used under various development conditions, the report makes estimates of the amount of travel and the distribution by mode of that travel at peak times to and from jobs on the Far West Side for each of the six scenarios for five year intervals from 2010 to 2040. The report also examines the impact that the added volumes of Flushing line travel would have at key locations on the subway system already under stress from overcrowding, notably the transfer passages to and from the Flushing line station at Grand Central Terminal and on the Lexington Avenue express subway line.

In addition to the Flushing line proposal, the report looks at additional demand for travel across the Hudson to and from the Far West Side and the implications for a new rail passenger tunnel currently under study. The report discusses the possible role for other modes, including light rail and ferries, and examines the added demands placed on the road system of added automobile traffic.

Findings:
While the #7 extension is needed to catalyze development, over the long-term the City's plan for providing transportation to a fully developed Far West Side will prove unable to handle the projected development unless several other regional transportation projects are completed simultaneously. Further, if these projects are not all completed, the #7 Flushing Line extension will have significant negative impacts on the transportation system as a whole.

- The one significant transportation improvement proposed in the City's plan – extension of the #7 Flushing Line – is needed to accommodate significant development. However, if projected development occurs, over the long-term the new line will become overcrowded and create significant problems in other parts of the city and region's transportation network, unless several related projects are completed.

o The Flushing Line will be unable to handle the demand for all but the least ambitious office scenario tested (half the City's plan -- 14 msf). If the aggressive 28 msf office development on the FWS proceeds, some time in the late 2020s or early 2030s the Flushing line will be overcrowded and other means of getting riders to and from points east of Eighth Avenue will be necessary. Even with a 21 msf office development on the FWS, the Flushing line would prove unable to handle the demand.

o However, substantial subway ridership may not materialize for quite some time; in four of the six scenarios it does not exceed levels of the lesser used lines in the subway system until after 2025. While this suggests that for the purposes of serving Far West Side development the capacity provided by the Flushing line may not be needed in the next 15 to 20 years, major commercial development is unlikely to proceed without the mobility enhancements of the Flushing extension. A delay of several years in the timetable for the extension is tolerable, and may even be prudent, given the outlook for the office market. However, it cannot be put off for too long if development is to proceed.

o The Flushing line extension creates an increasingly untenable situation at the Grand Central subway station complex. The volume of subway riders transferring in the currently "minor" direction of flow could grow to equal the "major" flow, clogging the narrow corridors, stairways, and escalators leading to and from the Flushing line station at Grand Central. This would

trigger the need for massive structural changes which may not be feasible, given the tight geometry of the station. In the absence of mitigation of this problem it can be expected that some travelers may choose sub-optimal subway routes creating longer trips, or choose not to work on the Far West Side. Mitigation would be better accomplished if transferees could be diverted elsewhere.

o **The Flushing line extension significantly adds to crowding on the Lexington Avenue line.** This already congested line would become even more crowded as East Side residents headed for jobs on the Far West Side utilize the Lexington Avenue line to access the #7 extension.

• **The most effective means of relieving the congestion created by FWS development is the construction of the Second Avenue subway, which shifts riders destined for the Far West Side from the East Side, the Bronx and Brooklyn who would no longer transfer at Grand Central.** Instead, many would use the Second Avenue subway's west side line to transfer at Times Square or the Second Avenue station at 42nd Street connected to the Flushing line. These findings strongly argue for the Flushing line extension proceeding only if the Second Avenue subway is built simultaneously. Thus, the full development on the Far West Side will not only require the building of the Flushing line extension, but lead directly to the need to complete the Second Avenue subway. An improved link between Penn Station and the Far West Side, which would shift Metro North and Long Island Rail Road riders who might otherwise travel through Grand Central Terminal, provides a much smaller level of relief.

• **Without a new rail passenger tunnel under the Hudson River (Access to the Region's Core), Far West Side development potential will be severely hampered, since it will be difficult to tap into the critical labor market from west of the Hudson.** Even without development on the Far West Side, the continued growth and strong shift toward commuters from the west will soon overwhelm the commuter rail system under the Hudson River and into Penn Station, the only Trans-Hudson mode with any significant remaining capacity. Without the availability of additional capacity from the west, the increment of growth projected for the FWS would be severely jeopardized, indicating that a new rail tunnel is essential to development there. In addition, the added demand created on Trans-Hudson travel by the FWS will restrict the labor force available to support job growth in other locations in Manhattan. From both perspectives, a new rail tunnel is a vital piece of infrastructure that needs to be integrated into planning for the Far West Side. This project is currently being studied as "Access to the Region's Core," and has received only qualified support from New York City.

• **The subway extension will have little trouble handling the travel demand created by any of the housing alternatives, although the housing generated volumes would add to the problems at Grand Central Terminal, discussed above.** However, without the Flushing line extension, all of the housing scenarios would tax a traditional bus operation. This suggests that a higher capacity mode be considered, such as light rail, with either bus rapid transit or some other transit technology. They may be able to handle these volumes generated by residential development more easily and could also be used to link the Far West Side to Penn Station and to the many tourist attractions and hotels in Midtown.

• **In the long run, all the scenarios tested suggest that the capacity provided by the Flushing line will be needed. With most of the scenarios indicating that eventually the line will be overcrowded, another transit mode to move people from within Manhattan to the Far West Side, such as light rail, can eventually complement, not compete with the Flushing line.**

• **Finally, the development on the Far West Side, absent strong shifts of policy toward the automobile and its use in Manhattan, will result in a proliferation of automobile traffic.** Five thousand peak hour cars and storage for more than 10,000 will be needed under the more aggressive scenarios, further clogging the already overtaxed arteries leading to the Far West Side, particularly the Henry Hudson Parkway / West Street corridor and the approaches to the Lincoln Tunnel. It is time for the City to begin a careful and comprehensive look at how to reduce traffic through pricing. This has been done successful in London without adversely affecting the economy.

• **Events at the stadium and convention facilities could further exacerbate auto congestion, potentially creating an untenable situation on days when the stadium is used for sporting events or concerts.** The situation would be especially problematic for any weeknight events. Based on data for events at Madison Square Garden, we find the Jets' estimates for mass transit ridership appear to be overly optimistic and in need of independent review.

II. Introduction

New York City's plans to develop the Far West Side (FWS) of mid-town Manhattan, the area roughly bounded by Eighth Avenue, 42nd Street, 30th Street and the Hudson River, represents the potential for a major expansion to the region's Central Business District (CBD). The plan calls for 28 million square foot of new office development, 12,000 new units of housing, expanded convention, retail and hotel space, and a new football stadium/convention space. There is widespread recognition that major investments in transportation access are the key to redeveloping the area. There is less appreciation that the realization of this plan, or even a substantial portion of it, would have major implications for the entire transportation network that serves the Manhattan CBD. Much of this network—subway lines, commuter railroads, transportation hubs, auto crossings and streets—is at or near capacity. With the potential for over 100,000 new office workers, 25,000 new residents and increases in visitors, tourists and shoppers, the development will put additional strains on this system with more people entering Manhattan from all directions.

Therefore, analysis of the transportation implications for the Far West Side must not be limited to the capacity improvements needed to reach the district. It must also include an assessment of the how the district will affect capacity and mobility throughout the system. Because the pace and mix of development on the Far West Side (FWS) is uncertain[1], this report posits a number of development scenarios and tests how well a variety of proposed transportation projects, either in isolation or in combination would meet the travel demand generated by each scenario and the burden it would impose on the transportation system.

Development Scenarios

New York City has proposed that the FWS development known as the Hudson Yards Rezoning and Development Program (HYRD), include 28 million square feet (msf) of commercial non-residential floorspace and 12,000 units of housing, to begin to come on-line in 2010 and then to be developed over a 30 year period. We will examine in this report the transportation consequences of six alternatives, including the City's (to be referred to here as Scenario 1) and five others that vary the amount and mix of development, and the pace and starting point of construction. The development levels tested here are not assigned any probabilities, but are constructed to provide a range of parameters for testing the sensitivity of the conclusions about transportation projects and policies. The scenarios are shown in Table 1.

The second scenario emphasizes housing with a shift in the mix of development with non-residential floorspace dropping by _ to 21 msf and housing growing by 2/3 from 12,000 to 20,000 units. The third scenario keeps the City's 12,000 housing units but drops the non-residential development still further by _ to 14 msf. The first three scenarios each assume that non-residential development would begin in 2010 and occur evenly over the next 30 years to 2040, while housing construction would also begin in 2010 and be completed by 2025. All scenarios assume that strong demand for housing will result in a shorter build-out period for housing than office.

In scenarios 4, 5, and 6 the mix of developments would mirror 1, 2, and 3 but the non-residential development would be delayed, not starting until 2020, but would come online at a faster pace once begun, with completion by 2040, as with the other three scenarios.

Land Uses and Travel Demand

The evaluation of the transportation system in this report is based on the peak hour use of the transportation system, the time when it is under the most stress. Fortunately, the mix of uses on the FWS, primarily offices and housing, will tend to place burdens on the transportation system in distinctly different patterns. Work travel will primarily enter the area in the morning peak period and leave in the evening peak period, while the peaks generated by residents will follow the opposite pattern – with people leaving the FWS in the morning and entering the area in the evening. As will be seen below, trips generated by the office buildings will place a far greater burden on the transportation system than do trips generated by residences. Therefore, the approach taken here is to focus first on trips made from home to work in office buildings and back to home. The demands placed on the transportation system from residential developments are then considered.

Table 1 - Development Scenarios

Scenario	Amount of non-residential, msf	# of Housing Units	Pace of Non-residential Development *
1. City Proposal (HYRD)	28	12,000	2010 to 2040
2. Greater Housing Emphasis	21	20,000	2010 to 2040
3. Less Office Emphasis	14	12,000	2010 to 2040
4. City Proposal But Starts Later	28	12,000	2020 to 2040
5. Greater Housing Emphasis and Less Office Emphasis, Starts Later	21	20,000	2020 to 2040
6. Less Office Emphasis, Starts Later	14	12,000	2020 to 2040

*** All scenarios assume all development will occur evenly over the period shown. All scenarios assume housing will be developed over a 15-year period from 2010 to 2025.**

Estimating How Much Travel is Generated on the Far West Side. A primary source for transportation planning analysis is the work trip data collected by the US Census. Unfortunately, work trips by mode of travel from the 2000 Census has been not yet been made available at a useful level of detail and may never be available at the level of detail useful for transportation planning purposes.[2] Therefore, the analyses herein are based on a combination of sources, including total trips by origin and destination from the 2000 Census, work trips by mode of travel from the 1990 Census journey to work data, the Hub-bound travel series, and RPA's earlier work on travel demand in Midtown Manhattan.[3] Given the limitations imposed by data, the tact taken here is to establish a number of ways to get at the result, and then attempt to corroborate them with one another. Rather than relying on models based on a long string of assumptions that tend to propagate errors, we estimate travel demand in a number of different ways using "short stubby" models[4] that do not depend on outputs of one step feeding the next one.

The initial task is to estimate the number of trips that would be generated by each type of development – office and residential. The methodology for doing this is provided in Appendix A. Two approaches to estimating office building peak period trip-making were developed. In one approach, a trip rate of 2,235 trips per million square feet in the morning peak hour was estimated, and in the second approach the trip generation rate for offices was estimated at 2,088 trips per million square feet in the morning peak hour. Because the two approaches yielded similar results, there is a high level of comfort in using either of these, or an average of both. Also, the closeness of the results gives an increased level of comfort using the trip rates for the other uses, residential, retail and restaurant developed in Approach 1. Thus, for this report the trip generation rates shown below for offices and residential land uses are used. While trip generation rates for retail and restaurant space were developed, they are not used in this report because they do not occur during traditional commuting hours and they are usually combined with office building-related trips when they do occur in the peak.

Trip Generation Rates

OFFICES
- morning peak hour
- 2,150 per 1 msf
- evening peak hour
- 2,350 per 1 msf

RESIDENTIAL
- morning peak hour
- 625 per 1,000 units
- evening peak hour
- 700 per 1,000 units

Based on these trip generation rates the number of trips for each scenario is calculated for five year increments from 2010 to 2040. Table 2 shows the results of these calculations for morning peak hour and evening peak hour trips generated for offices and residences.

The focus now turns to how to accommodate the trips generated by offices, since they are likely to be taken in the peak direction at peak times. If a transportation system can accommodate them, then trips generated to and from residences will not pose a problem. But first we must understand where people traveling

Table 2
Peak Hour Trips to and from Offices and Residences in Five Year Increments by Scenario

Scenario	1	2	3	4	5	6
Office Space, msf	28	21	14	28	21	14
Housing units (000)	12	20	12	12	20	12
Office Pace	2015 - 2040	2015 - 2040	2015 - 2040	2025 - 2040	2025 - 2040	2025 - 2040
Housing Pace	2010 - 2025	2010 - 2025	2010 - 2025	2010 - 2025	2010 - 2025	2010 - 2025
By 2010						
am office	0	0	0	0	0	0
pm office	0	0	0	0	0	0
am residential	1,875	3,125	1,875	1,875	3,125	1,875
pm residential	2,100	3,500	2,100	2,100	3,500	2,100
By 2015						
am office	10,033	7,525	5,017	0	0	0
pm office	10,967	8,225	5,483	0	0	0
am residential	3,750	6,250	3,750	3,750	6,250	3,750
pm residential	4,200	7,000	4,200	4,200	7,000	4,200
By 2020						
am office	20,067	15,050	10,033	0	0	0
pm office	21,933	16,450	10,967	0	0	0
am residential	5,625	9,375	5,625	5,625	9,375	5,625
pm residential	6,300	10,500	6,300	6,300	10,500	6,300
By 2025						
am office	30,100	22,575	15,050	15,050	11,288	7,525
pm office	32,900	24,675	16,450	16,450	12,338	8,225
am residential	7,500	12,500	7,500	7,500	12,500	7,500
pm residential	8,400	14,000	8,400	8,400	14,000	8,400
By 2030						
am office	40,133	30,100	20,067	30,100	22,575	15,050
pm office	43,867	32,900	21,933	32,900	24,675	16,450
am residential	7,500	12,500	7,500	7,500	12,500	7,500
pm residential	8,400	14,000	8,400	8,400	14,000	8,400
By 2035						
am office	50,167	37,625	25,083	45,150	33,863	22,575
pm office	54,833	41,125	27,417	49,350	37,013	24,675
am residential	7,500	12,500	7,500	7,500	12,500	7,500
pm residential	8,400	14,000	8,400	8,400	14,000	8,400
By 2040						
am office	60,200	45,150	30,100	60,200	45,150	30,100
pm office	65,800	49,350	32,900	65,800	49,350	32,900
am residential	7,500	12,500	7,500	7,500	12,500	7,500
pm residential	8,400	14,000	8,400	8,400	14,000	8,400

to work on the FWS begin their trips and what modes they use.

Origins and Mode of Travel for Work Trips. Planners rely on relationships developed from past data on travel to work patterns and modes chosen by travelers. The US Census for 2000 surveyed a sample of work trip characteristics for all workers traveling to work during a week in April 2000.[5] This sample provides counts of workers from each county in the region, both for Manhattan as a whole and for Manhattan subdivided at the census tract level. However, the unavailability of information by mode of travel, almost four years after it was collected, requires us to apply modal shares using the 1990 Census. This adds to the range of error for travel estimates made for the different scenarios, but, with the adjustments for major transportation changes described below, it is very unlikely that the change in modal shares between 1990 and 2000 would be large enough to affect the conclusions reached here.

Each county in the Region was assigned a share of the origins for Manhattan workers, guided by a combination of the 2000 data for all work trips to Manhattan and residential locations of the work force for seven census tracts on the west side roughly bounded by 6th Avenue, 42nd Street, the Hudson River and 30th Street. Each county was assigned a mode share distribution based on the 1990 data and updated based on known changes in the transportation network since then.[6] The county-of-origin assumptions are shown in Table 3. The five boroughs of New York City are estimated to contribute 65 percent of the labor force for Manhattan's jobs; counties west of the Hudson, including 14 in New Jersey, four in New York State, and one in Pennsylvania account for 17.4 percent of the workers, now more than both the northern and eastern (Long Island) suburban sectors combined. Table 4 shows the results of applying the origin, mode and trip generation rates for the incremental office space for Scenario 1 in 2015. In this table the total number of trips equals the corresponding scenario/year combination from Table 2. By applying the ratio of trips generated for each scenario and year combination from Table 2, to the entries in Table 4, the number of trips by mode and by origin can be calculated for all scenarios.[7]

Table 3
Percent of Work Trips to Manhattan in 2000 from Each County

County	Percent	County	Percent
Bergen	3.63	Dutchess	0.25
Essex	1.50	Putnam	0.21
Hudson	3.30	Westchester	3.92
Hunterdon	0.08	**NYS E of HR**	**4.37**
Mercer	0.39		
Middlesex	1.86	Fairfield	1.19
Monmouth	1.53	Litchfield	0.21
Morris	0.65	New Haven	0.04
Ocean	0.32	**Connecticut**	1.43
Passaic	0.76		
Somerset	0.40	Nassau	7.61
Sussex	0.11	Suffolk	3.82
Union	0.83	**Long Island**	**11.43**
Warren	0.06		
Orange	0.70	Bronx	8.98
Rockland	1.08	Brooklyn	19.99
Sullivan	0.00	Manhattan	16.00
Ulster	0.11	Queens	18.24
Pike	0.10	Staten Island	2.16
West of Hudson	**17.39**	**New York City**	**65.38**
		Region	**100.00**

Table 4

Trips to Work to Far West Side in Morning Peak Hour
Without New Hudson River Rail Tunnel
2015 - Scenario 1

	Total Trips	Auto	Subway	Bus	Commuter Rail	Ferry	PATH	Taxi	Walk to Work
Bergen	364	135	0	116	76	36	0	0	0
Essex	150	42	0	45	51	0	12	0	0
Hudson	331	50	0	93	0	50	139	0	0
Hunterdor	8	3	0	2	2	0	0	0	0
Mercer	39	8	0	4	27	0	0	0	0
Middlesex	187	37	0	65	82	0	2	0	0
Monmouth	154	35	0	66	45	5	3	0	0
Morris	65	24	0	18	21	0	2	0	0
Ocean	32	7	0	17	6	1	1	0	0
Passaic	76	30	0	33	11	0	2	0	0
Somerset	40	12	0	7	20	0	1	0	0
Sussex	11	4	0	6	1	0	0	0	0
Union	83	20	0	16	44	0	3	0	0
Warren	6	2	0	2	1	0	0	0	0
Orange	70	34	0	17	18	0	1	0	0
Rockland	108	68	0	24	14	0	2	0	0
Sullivan	0	0	0	0	0	0	0	0	0
Ulster	11	5	0	4	2	0	0	0	0
Pike	10	4	0	5	1	0	0	0	0
WHR	1747	520	0	540	425	92	169	0	0
Dutchess	25	9	0	0	17	0	0	0	0
Putnam	21	6	0	0	13	0	0	0	0
Westchest	393	106	24	16	251	0	0	0	0
CT	143	24	0	3	115	0	0	0	0
E of HR	583	145	24	19	396	0	0	0	0
Nassau	764	183	46	16	528	0	0	0	0
Suffolk	383	96	11	8	273	0	0	0	0
Long Islar	1147	279	57	23	801	0	0	0	0
Bronx	901	162	595	119	27	0	0	0	0
Brooklyn	2006	241	1625	143	0	0	0	0	0
Manhattar	1605	112	674	257	0	0	0	80	482
Queens	1830	329	1263	149	93	0	0	0	0
Staten Isla	217	61	17	84	7	51	0	0	0
New York	6559	905	4174	752	127	51	0	80	482
WHR	1,747	520	0	540	425	92	169	0	0
E of HR	583	145	24	19	396	0	0	0	0
LI	1,147	279	57	23	801	0	0	0	0
NYC	6,559	905	4,174	752	127	51	0	80	482
TOTAL	**10,035**	**1,850**	**4,255**	**1,334**	**1,749**	**142**	**169**	**80**	**482**

Note:
Scenario 2 is 75 Percent of Scenario 1
Scenario 3 is 50 Percent of Scenario 1
Scenarios 4, 5 and 6 are Zero Percent of Scenario 1

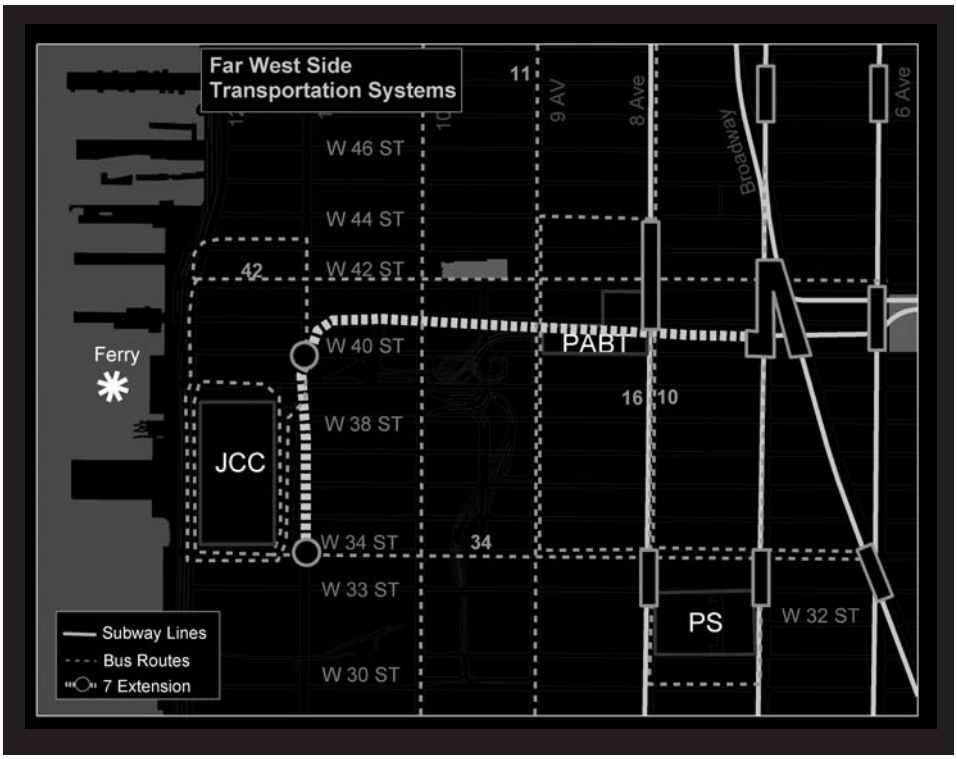
Current Transportation System on the Far West Side

With few exceptions, as shown in Map 1, the public transit system on the FWS ends at or near its eastern border of Eighth Avenue. The westernmost north-south subway line in Midtown is under Eighth Avenue (A, C, and E lines) with stops at 34th and 42nd Streets. Other subway lines run under Seventh Avenue, Broadway, and Sixth Avenue, progressively farther east; each stops at the same two cross streets. The #7 Flushing line running east-west has its western terminus under 41st Street at Seventh Avenue, part of the Times Square subway station complex, and has two other stops in Manhattan, one at Grand Central Terminal at Lexington Avenue and the other at Fifth Avenue.

The Port Authority Bus Terminal (PABT), occupying nearly two full blocks from 40th to 42nd Streets and from Eighth to Ninth Avenue, brings travelers from west of Hudson to Manhattan. To the south between 33rd and 31st Streets and from Seventh to Eighth Avenues stands Penn Station (PSNY), serving as the entryway for commuter rail riders from Long Island to the east on the Long Island Rail Road and from the west using NJ TRANSIT. Amtrak also serves the station, the busiest in its national network. PSNY will be expanded with the construction of the Moynihan Station by converting the Farley Post Office building across Eighth Avenue for use by Amtrak riders.

There are four NYC Transit bus routes that serve some part of the FWS. Two crosstown routes run along 34th and 42nd streets river to river and each loops around the Javits Convention Center between Eleventh and Twelfth Avenues. The #11 bus route operates on the north-south one-way pair of Ninth and Tenth Avenues. And the #16, a second 34th Street crosstown route, touches the FWS by using Ninth Avenue as part of its loop to and from the PABT.

Finally, New York Waterway operates ferry service to 38th Street on the Hudson River and has just begun the construction of a $35 million expanded ferry terminal at 39th Street. Ferry service is operated from nine locations in New Jersey – two from Weehawken, two from Hoboken, three from Jersey City and one (with a stop on the East River in Lower Manhattan) from Monmouth County. By far the most popular of these is the Weehawken route located opposite 48th Street in Manhattan. New York Waterway provides a number of connecting bus routes in Manhattan.



Transportation Plans Under Consideration

Currently, by far the most visible transportation project being considered to serve the FWS is the extension of the #7 Flushing subway line, but there are other concepts worthy of consideration, not necessarily as a substitute to the #7, but as complementary. The Flushing line extension and these other projects are described below.

Extension of #7 Flushing Line. The City has proposed that the #7 Flushing subway line that now terminates at a station under Seventh Avenue and 41st Street near Times Square be extended farther west. At the City's request, the MTA is studying the possibility with results to be made public by late spring in a Draft Generic Environmental Impact Statement being done for the Hudson Yard Rezoning and Development Program. The line now provides for transfers at its three Manhattan stops: Grand Central Terminal (with the #4, 5, 6 and 42nd Street shuttle lines), Fifth Avenue (using a corridor walk to reach the B, D, F, and V lines) and Times Square (with the 1/9, 2, 3, A, C, E, N, R, Q, W and the 42nd Street shuttle lines). In Queens the #7 also offers numerous transferring options (at Queensboro Plaza and Roosevelt Avenue – Jackson Heights).

The MTA initially examined two alignments extending from Times Square. One alignment would turn immediately south under Eighth Avenue and then west under 34th Street, serve the Penn Station area and then head west toward the FWS. This alignment has since been rejected because of cost and construction difficulties under Eighth Avenue and the sharp turns required. The second alignment, now the only one being considered by the MTA, would extend the Flushing line westward under 41st Street and turn south either under Eleventh Avenue or under the railroad cut carrying Amtrak trains from Albany into Penn Station terminating at or near 34th Street. Many observers have suggested that this alignment is deficient because it bypasses PSNY and should be extended by doubling back toward PSNY from the proposed terminus at 34th Street near Eleventh Avenue. To date, there is no sign that the MTA is examining that option. Throughout public discussion about the extension of the #7 the City has stated that funding for the project would not be taken from the MTA's other transit expansion priorities, including the Second Avenue Subway and the LIRR East Side Access project.

Instead, the City has issued a plan that explains how the project could be financed using the added value of development that would be created by the 7 extension and other public investments to pay for financing them.

Commuter Rail. Commuter rail capacity under the Hudson River to carry west of the Hudson travelers to Manhattan is the subject of an Environmental Impact Statement process that has just begun under the aegis of NJ TRANIT and the Port Authority of New York and New Jersey. Growth is projected to consume available trans-Hudson peak period rail capacity before 2010, with other modal options incapable of absorbing much if any of it. Over the last 20 years commuting from points west of the Hudson to Manhattan has captured virtually all of the growth from the suburbs. Past work has led to two alternatives, each with a station connected to the existing Penn Station. But each of these alternatives is deficient in two respects. First, neither provides for redundancy in the event that the existing system – tunnel and PSNY – are unable to be used in the event of an emergency or for repairs, and second, neither brings riders directly to the east side where the majority of riders are destined.

RPA has suggested that the rail tunnel be extended under 34th Street to the east side, then under Madison Avenue, stopping there and then continuing west under 50th Street and then to the FWS, possibly under Eleventh Avenue or the Amtrak cut. This loop could be used to deliver west of Hudson riders directly to the FWS, as well as link the FWS to other parts of Midtown. A fuller discussion of this proposal is in The Case for a New Hudson River Passenger Rail Tunnel, available on RPA's website, www.rpa.org.

"People-Mover" Connection Between Penn Station and the West Side. In the 1980s the MTA examined transit options to connect the Penn Station area to the Hudson Yards. At that time it was in anticipation of a possible move by Madison Square Garden to the site over the rail yards. The MTA concluded that the most feasible option was one that traveled underground using an existing tunnel under 33rd Street. Part of that tunnel is no longer available. However, should the Flushing line not be turned back east and extended to Eighth Avenue and the Penn Station area, then this possibility could be re-explored. Other possibilities are bus rapid transit systems designed to speed buses past traffic on their own rights of way or where they are given priority, or rail systems either at grade or elevated using either light rail or "monorail" vehicle technologies.

Light Rail. For at least 25 years the concept of using light rail vehicles on the street surface to serve midtown has been contemplated. For many years the 42nd Street Development Corporation proposed a light rail line on 42nd Street, operating from First Avenue near the United Nations to the Hudson River. In the early 1990s the Dinkins Administration invited proposals for its construction, but the idea died in the Giuliani Administration, under the weight of opposition from those concerned about traffic diversion impacts (eastbound traffic would be barred from 42nd Street) and from Con Edison, who was concerned about reaching their facilities under the light rail line. In 1996, as part of its Third Plan, RPA proposed a more ambitious light rail line – a Midtown light rail loop that would extend the 42nd Street line south on the west side along either West Street or Eleventh Avenue, then across 34th Street to Herald Square and then north up Broadway as far as Lincoln Square. Recently, a small group of planners have tried to revive the 42nd Street concept under the rubric of Vision 42.

The recent interest in the preservation of the High Line has also generated interest in light rail. The High Line, a north-south elevated structure between Tenth and Eleventh Avenue and extending from about 14th Street to 30th Street and then looping west around the Hudson Rail Yard, was built in the 1930s to carry rail freight, but has long since been abandoned for that purpose. In 1999 RPA, at the request of the High Line's owner, the rail freight company CSX, examined possible transportation uses for the line and concluded that its elevated status and its position away from concentrated transit markets could not support rail transit on the right-of-way. Instead, RPA suggested it be converted to a promenade, which is currently being pursued by the City.

Ferries. The new ferry facilities at 39th Street on the Hudson River are well situated to attract riders destined for the FWS. As demand warrants there will be opportunities to reinforce existing routes with more service and additional routes. However, ferry options are limited by the remaining markets that may be accessible to the waterfront, and would competing in time and cost with ground options. Thus, ferries can be a useful supplement, but not a replacement for new transit capacity.

Testing the Flushing Line Extension and Its Implications for the Transit Network

There are a number of unanswered questions about this proposal. Will it carry enough riders and when will these riders materialize to justify its construction? Alternatively, will it be oversubscribed and when might that occur, requiring other forms of transportation to carry the expected travel demand? And will the addition of riders transferring to and from the Flushing line to reach the FWS overwhelm the existing lines or the transfer locations?

In addition to applying what we have learned about travel patterns to future land use scenarios we must account for existing patterns of travel to the FWS. This "base case" tells us how many people are traveling to the FWS today and what form of transportation system they are using now and likely to take in the future. Current ridership if the Flushing line existed today was developed by using the methodology described above for the five tracts located west of Eighth Avenue between 42nd and 34th Streets. Only 14% of destinations were estimated to have been located west of Tenth Avenue, north of 28th Street, and are therefore candidates to use the Flushing line extended to 34th Street and Eleventh Avenue. Base case trips were then allocated to various entry points to the Flushing Line (either in Queens, at Grand Central Terminal, Fifth Avenue, or Times Square) and included a) subway riders from the five boroughs, b) riders from the north transferring at Grand Central Terminal, c) an estimated one-third of Long Island Rail Road riders who would use LIRR East Side Access and transfer at Grand Central with the remainder continuing to use Penn Station, and d) bus commuters to the PABT from west of the Hudson who would transfer at Times Square. Taking account of all these markets, it was estimated that in the peak hour about 2,500 would use the Flushing line to reach their jobs. In Table 5 the pattern of boardings and the counties of origin for transferees to the Flushing line is depicted. Of the 2,500 who would

Table 5
Transferrees to Flushing Line for Current Far West Side Workers
By County of Origin and Point of Entry - Peak Hour

	Transfer Point /Entryway			
Origin / Prior Mode	Times Square	Fifth Avenue	Lex / GCT	#7 from Queens
NJ / PABT	205	0	0	0
No. Suburbs /Metro North	0	0	126	0
LI / LIRR via ESA	0	0	130	0
Bx - Subway	232		155	0
Brooklyn / Subway	297	148	297	0
Manhattan / Subway	89	44	89	0
Queens / Subway	503		0	166
Richmond / Ferry/ Subway	20	0	0	0
	1,346	**192**	**797**	**166**

Total on Flushing Line West of Eighth Avenue = 2,501

Table 6
Evening Peak Hour Riders on Flushing Line at Maximum Load Point
By Year and Scenario

Scenario	1	2	3	4	5	6
Office Space, msf	28	21	14	28	21	14
Office Pace	2015 - 2040	2015 - 2040	2015 - 2040	2025 - 2040	2025 - 2040	2025 - 2040
Year						
2010	2,500	2,500	2,500	2,500	2,500	2,500
2015	8,401	6,926	5,451	2,500	2,500	2,500
2020	14,302	11,352	8,401	2,500	2,500	2,500
2025	20,203	15,778	11,352	11,352	9,139	6,926
2030	**26,105**	20,203	14,302	20,203	15,778	11,352
2035	**32,006**	**24,629**	17,253	**29,055**	22,416	15,778
2040	**37,907**	**29,055**	20,203	**37,907**	**29,055**	20,203

transfer to the Flushing line today over half would likely board at Times Square and about 1/3 at Grand Central Terminal.

Using this line of reasoning for future scenarios, the number of evening peak hour trips was calculated and the results are shown in Table 6 for trips generated by projected office space for each of the scenarios in five-year increments that would use the # 7 eastbound at its maximum load point west of Eighth Avenue. Table 6 shows, not surprisingly, that in the early years volumes would be low, and would exceed 10,000 riders per hour by 2020 only for scenarios 1 and 2. By 2030 all the scenarios would pass 10,000 riders and Scenario 1, with its high office space assumptions and earlier start on construction would exceed 26,000 riders per hour. This last number is significant because this level of ridership would exceed comfortable crowding standards. Table 6 shows the entries in bold that would exceed such standards.[8]

Table 6 is constructive in two ways: first it suggests that substantial subway ridership will not materialize for quite some time; in four of the six scenarios it will not exceed about 11,000 riders until about 2025. By way of comparison all New York City subway lines entering Manhattan exceed that peak hour use today, and most carry twice as that or more. On the other hand, the table also suggests that eventually all but the 14 msf office scenarios will bring us to an overcrowded Flushing Line, albeit in some cases not until 2040.

By 2040 the scenarios with 21 msf or 28 msf would well exceed the Flushing line's capacity. This leaves us with the following conclusions:

• If the aggressive 28 msf office development on the FWS proceeds, some time in the late 2020s or early 2030s the Flushing line will be overcrowded and other means of getting riders from points east of Eighth Avenue will be necessary.

• Even with a 21 msf office development on the FWS, the Flushing line would prove unable to handle the demand.

• The capacity provided by the Flushing line may not be needed in the next 15 to 20 years, if the target of 28 msf is scaled down and /or the pace of development (after 2020 start) is slower.

What of the impact of the added Flushing line ridership on the other subway lines and transfer points used to reach the #7? And will it have the effect of overburdening other portions of the subway system that travelers use to reach the #7 line? In Table 7 the number of peak hour riders

Table 7: Evening Peak Hour Riders Transferring at Grand Central Terminal to the Flushing Line By Year and Scenario

Scenario	1	2	3	4	5	6
Office Space, msf	28	21	14	28	21	14
Office Pace	2015 - 2040	2015 - 2040	2015 - 2040	2025 - 2040	2025 - 2040	2025 - 2040
From Lexington Avenue Line, Metro North and LIRR Combined						
Year						
2010	797	797	797	797	797	797
2015	2,777	2,282	1,787	797	797	797
2020	4,756	3,766	2,777	797	797	797
2025	6,736	5,251	3,766	3,766	3,024	2,282
2030	8,715	6,736	4,756	6,736	5,251	3,766
2035	10,695	8,220	5,746	9,705	7,478	5,251
2040	12,674	9,705	6,736	12,674	9,705	6,736
If Two Thirds of Metro North Riders Able to Travel Direct to Penn Station						
Year						
2010	797	797	797	797	797	797
2015	2,363	1,951	1,539	715	715	715
2020	4,010	3,186	2,363	715	715	715
2025	5,658	4,422	3,186	3,186	2,569	1,951
2030	7,305	5,658	4,010	5,658	4,422	3,186
2035	8,953	6,894	4,834	8,129	6,276	4,422
2040	10,601	8,129	5,658	10,601	8,129	5,658
If Second Avenue Subway is Built; Metro North Riders Continue to GCT						
Year						
2010	378	378	378	378	378	378
2015	1,538	1,248	958	378	378	378
2020	2,697	2,118	1,538	378	378	378
2025	3,857	2,987	2,118	2,118	1,683	1,248
2030	5,017	3,857	2,697	3,857	2,987	2,118
2035	6,177	4,727	3,277	5,597	4,292	2,987
2040	7,336	5,597	3,857	7,336	5,597	3,857
Added Ridership Northbound on Lexington Avenue						
Year						
2010	215	215	215	215	215	215
2015	707	584	461	215	215	215
2020	1,199	953	707	215	215	215
2025	1,691	1,322	953	953	768	584
2030	2,183	1,691	1,199	1,691	1,322	953
2035	2,674	2,060	1,445	2,428	1,875	1,322
2040	3,166	2,428	1,691	3,166	2,428	1,691

transferring at Grand Central Terminal is shown for all the benchmark years and scenarios in the first sub-table.[9] A recent count of pedestrian flows in and out of the Flushing line station is a helpful point of departure.[10] A morning peak volume of 10,600 people was counted departing the station (not including the numbers exiting at the east end station to the street). Slightly fewer than 2,000 were counted entering the station. If the evening peak hour were to mirror these volumes then 2,000 would be making their way up from the station and 10,600 down.

In the first sub-table in Table 7 the numbers to be added to the evening "up" volumes for the various scenarios are shown. For example, under Scenario 1 by 2030 about 8,700 people would be added to the "minority flow" of 2,000 today, creating a flow of about 10,600 in each direction. Even a casual inspection of that station suggests that such a situation would be untenable, and massive changes to the station would be required, which might be impossible given the complexity of the station. While with a less aggressive build-out the problem would be less acute, Table 7 strongly indicates that all the scenarios will eventually lead to serious circulation problems at this station. In the absence of mitigation of this problem it can be expected that some travelers may choose sub-optimal subway routes creating longer trips or choose to work in places that do not require a transfer to the Flushing line at Grand Central.

There are a number of system changes that could lessen this problem. Metro North has been studying the possibility of providing access to Penn Station.[11] If this ever results in operating trains there, perhaps two-thirds of the contribution made by Metro North transferees might disappear.[12] The results of this are shown in the second sub-table in Table 7. But this would still leave about 80 percent of the volumes shown in the first sub-table clogging the passageways up from the Flushing line. Another approach would be to create a connection from Penn Station to the FWS, either a separate mode or the extension of the #7 to Penn Station. This could divert the LIRR riders assumed to use GCT once the East Side Access project is opened. But this would not have an appreciable impact on the numbers in Table 7's first sub-table.

A more significant drop in these volumes would come about if Lexington Avenue riders chose to shift to the Second Avenue subway, either to a new service to the west side or by transferring to the Flushing line at a new stop at 42nd Street and Second Avenue. The Second Avenue service planned from the upper East Side to west midtown and then on to Lower Manhattan and Brooklyn would siphon off riders transferring at Grand Central Terminal coming from the Bronx, Manhattan and Brooklyn. The third section of Table 7 shows a plausible impact from this, which would remove about one-third of the transferees. Along with Metro North riders' shifts, the impact would be to lower the transferee volumes by more than half.

The fourth sub-table in Table 7 shows the number of added riders on the Lexington Avenue line in the evening peak hour that would result from each of the scenarios. As of 2000, the Lexington Avenue express carried some 23,000 people in the evening peak hour on 22 trains, or about 1,050 per train. Examined in that light the last sub-table in Table 7 suggests that without any means of diverting traffic from the Lexington line, all but the least aggressive scenario will eventually create demand for two packed trains an hour under Lexington Avenue, and that all of the scenarios will eventually add demand for the equivalent of one more packed train per hour on the Lexington line. To highlight these impacts the entries in the table are shaded with the lightest shade showing where from _ to 1 _ train equivalents would be generated, the second shade, 1.5 to 2.5 train equivalents, and the darkest shade shows where more than 2.5 train equivalents would be needed. It is clear then that the Flushing Line's extension is likely to create even more serious crowding problems on the east side than exists today on the Lexington Avenue line and at the transfer at Grand Central. It is equally clear that the completion of the Second Avenue Subway would go a long way to alleviating these problems, particularly if most or all of the full build-out of the FWS occurs.

The impact of added riders on the Flushing line crossing the East River was examined too, suggesting that about a 7 percent addition to trip volumes at that cordon would occur. This would also add to crowding on the subways, and would be alleviated by a shift in subway riders in Queens who might indirectly benefit from the construction of the Second Avenue Subway.

A New Passenger Rail Tunnel Under the Hudson

How would a new passenger rail tunnel under the Hudson River, which is of great benefit to the mobility and economy of both New Jersey and New York,[13] assist the transportation needs of the FWS? Conversely, how would development of the FWS add to the need for a new tunnel? It can be expected that over time there will a higher share of Manhattan-bound commuters originating west of the Hudson than do today. Currently, about 17.4 percent come from west of the Hudson. The share has been growing rapidly in the last few decades; from 1980 to 2000 almost all (89 percent) of the growth in suburban commuting to Manhattan has been from the west. It can also be hypothesized that the FWS developments will attract a disproportionate share to work there since it is nearer to the Hudson River, and has the proximity of Penn Station, the Port Authority Bus Terminal and the Lincoln Tunnel. The availability of added housing on the FWS could dampen this effect somewhat.

For this analysis we assume conservatively that 25 percent of FWS workers will originate west of the Hudson[14] and that the share from each county using commuter rail will grow slightly with the availability of a new tunnel, except in counties such as Bergen, Rockland and Union where the availability of a new tunnel will attract a substantially higher share to rail. In Table 8 the results of these calculations are shown for the increment of growth of offices on the FWS for each benchmark year and scenario, accounting for the current work trip volumes as well. It is expected that with the new rail tunnel in place, about 8.5 percent of the workers on the FWS will arrive from points west of the Hudson and use the two sets of tunnels into the PSNY area.

With the current demand expected to match capacity by 2009, any increase in volumes associated with FWS growth would not be accommodated, strengthening the value of the new tunnel to New York City's aspirations for the FWS. --- This has implications not only for the Far West Side, but for job growth throughout New York City. Without the availability of additional capacity from the west, the increment of growth projected for the

Table 8

Evening Peak Hour Riders Using Commuter Rail from West of Hudson

Scenario	1	2	3	4	5	6
Office Space, msf	28	21	14	28	21	14
Office Pace	2015 - 2040	2015 - 2040	2015 - 2040	2025 - 2040	2025 - 2040	2025 - 2040
Year						
2010	204	204	204	204	204	204
2015	1,145	910	675	204	204	204
2020	2,086	1,616	1,145	204	204	204
2025	3,027	2,322	1,616	1,616	1,263	910
2030	3,969	3,027	2,086	3,027	2,322	1,616
2035	4,910	3,733	2,557	4,439	3,380	2,322
2040	5,851	4,439	3,027	5,851	4,439	3,027

FWS would be severely jeopardized, indicating that a new rail tunnel is essential to development there. In addition, the added demand created on Trans-Hudson travel created by the FWS will restrict the labor force available to support job growth in other locations in Manhattan. From both perspectives, a new rail tunnel is a vital piece of infrastructure that needs to be integrated into planning for the Far West Side.

Housing, the Scenarios and Public Transit
As indicated earlier, the trips generated by the added housing units will tend to occur in the opposite direction as those generated by offices. And as Table 2 shows, the number of trips generated by new housing under any of the scenarios will be far less than trips generated by offices for any of the scenarios. Nevertheless, it useful to see what level of demand might be created by the new housing developments on the FWS.

The 2000 US Census reports that of the 743,000 residents of Manhattan who work, 85 percent, or some 631,000, work in Manhattan. The remaining 112,000 are scattered about the Region, mostly accounted for by Brooklyn (26,000), the Bronx (21,000), Queens (20,000), New Jersey (23,000), Westchester (7,500) and Long Island (7,600). Prospectively, those residing on the FWS will have a different pattern of work site destination than Manhattan taken as a whole and tend to be more oriented to Manhattan, especially to Midtown. As for the mode of travel, the 1990 US Census tells us that over 6 percent of people living and working in Manhattan work at home, 27 percent walk to work, 38 percent use the subway, 15 percent travel by bus, 9 percent use an automobile (as either driver or passenger), and 5 percent take a taxi. Using these data as a guide, we assume here that among those residing in a developed FWS, 90 percent of workers will work in Manhattan. Among those who leave home to travel to work, 30 pe-rcent will walk to work,[15] six percent will drive or be driven in an automobile, and 6 percent will use a taxicab. This leaves 58 percent either traveling by bus or subway, with the split among the two modes somewhat dependent on the availability of the Flushing line extension. With the extension in place, most but not all will use it either to reach points east in Midtown, or to transfer to north-south subway lines elsewhere in the City.

Assuming that the rate of trips generated in the evening peak hour is 700 per 1,000 units derived earlier, and that 80 percent of these trips are for work purposes, then each 1,000 units generates 320 subway or bus trips calculated as follows:

For trips within Manhattan: 700 x 0.80 x 0.90 x 0.58 = 292

For trips to other places in NYC accessible by subway: 700 x 0.80 x 0.10 x 0.50 = 28

For the housing scenarios with 12,000 units this would add 3,840 subway or bus trips and for the 20,000 units scenarios, 6,400 subway or bus trips. The Flushing line would certainly have the capacity to handle this "reverse volume", but it would place an added burden on the current peak direction for transferring at Grand Central and at Times Square, that would exacerbate the problems at those locations discussed earlier.

Beyond Buses
If the Flushing Line were not in place could buses handle the office and residentially generated flow, or might there be a need for a higher capacity mode than buses operating on city streets? With 6,400 peak direction riders spread over two east-west routes (2/3 on 42nd and 1/3 on 34th Street, and assuming 40 persons per bus for a comfortable standard), 107 buses per hour would be needed on 42nd Street (a bus every 34 seconds) and 53 would be needed on 34th Street, not accounting for current demand. These volumes would tax the operating bus system and suggests the possibility of higher capacity modes. Light rail, with a route serving both 42nd and 34th streets, would provide capacity of about 6,000 on each street (say 100 per train @ 60 per hour), handling 12,000 people. This volume is not exceeded on five of the six scenarios in 2020 and four of the six in 2025. This analysis suggests a serious look at light rail, since these volumes – 6,000 plus in one direction with the high housing scenario, and no more than 12,000 in the other are keeping manageable volumes for light rail with their higher per vehicle capacity. The lower volume direc-

tion generated by the residences would be handled more cost-effectively than buses, and the higher volume office-generated volumes would be less capital intensive than the Flushing line extension.

Recall that among the concepts for light rail is one proposed by RPA that would operate as a loop on 42nd Street and 34th Street and connect to all the north-south subway lines, pass near most major hotels,[16] the theater district, tourist sites, Grand Central Terminal, the PABT and PSNY. The last is worth emphasizing since a light rail link from PSNY to the FWS, included in this loop could fill in the missing piece not accounted for by the Flushing line extension.

Of course, in the long run, all the scenarios tested suggest that the capacity provided by the Flushing line will be needed. But in the long run four of the six scenarios would result in a seriously overcrowded Flushing line. Light rail, either put in place before the Flushing line is needed or later when the Flushing line is inadequate deserves a serious look. So does a system of bus rapid transit that might provide "like rail" service at low capital costs.[17] All this suggests that the timing of development, the desire for an early Flushing line construction related to the Olympics bid, and the mix of offices and housing are closely tied to one another and require continued exploration.

Other Modes into the Far West Side

In addition to commuters using the Flushing line extension or the rail tunnel under the Hudson, there are other modes of travel that would be used to reach the FWS: Table 9 shows an estimate of the mode shares likely and the absolute numbers for Scenario 3 traveling in the evening peak hour in 2030. Of course, for other scenarios and for other benchmark years the totals will vary. The table assumes that the Flushing line extension, the new Hudson Rail tunnel and the LIRR's East Side Access project are all in place. Table 9 shows a low number of ferry users, lower than appears reasonable. This is in part a product of limitations of using the 1990 data for much of the modal share estimates and reflects the uncertainty about which markets would be served by the 39th Street ferry terminal. To the extent that ferries play a larger role on travel to the FWS it is likely to divert travel from selected riverfront communities to the north.

Table 9
Mode and Route to FWS - Scenario 2, 2030

	Number	Percent
Flushing Line - transfer from other subway	15,836	38.5
Flushing Line - transfer from MN	1,558	3.8
Flushing Line - transfer from LIRR/GCT	1,090	2.7
PABT	2,664	6.5
Local Bus	2,459	6.0
Other Bus	463	1.1
Penn Station - from NJ	3,529	8.6
Penn Station - from LIRR	2,181	5.3
PATH	994	2.4
Ferry	726	1.8
Taxi	299	0.7
Walk	1,793	4.4
Auto	7,533	18.3
TOTAL	41,124	100.0

The greatest cause for concern implied by Table 9 is the proliferation of travel by automobile, even with the three major transit projects in place. The 7,500 people in cars in the peak hour would translate to about 5,000 cars, allowing for some carpooling. In the entire peak period upwards of 10,000 vehicles would be entering the FWS and require storage there. Further clogging of the Lincoln Tunnel, the Henry Hudson Parkway and West Street would almost certainly result. There are no plans to add capacity to the roadway system leading to the FWS (nor should there be), suggesting that policies to reduce auto travel below what is projected here should be a priority. It is time for the City to begin a careful look at how to reduce traffic through pricing. This has been accomplished in London without adversely affecting the economy.

Events at the stadium and convention facilities could further exacerbate auto congestion, potentially creating an untenable situation on days when the stadium is used for sporting events or concerts. The situation would be especially concerning for any weeknight events. Based on data for events at Madison Square Garden, we find the Jets' estimates for mass transit ridership to be greatly inflated and in need of independent review.

III. Appendix A - Trip Generation Methodology

Two approaches are put forth here to estimate trip generation rates. In the first, the number of trips entering and leaving buildings of different uses – offices, residential, retail and restaurant – per unit of floorspace is estimated based on counts taken by RPA and published in Urban Space for Pedestrians.[18] Then the percent of those trips that occur in the highest peak hour are used to determine the peak hour trips per unit of floorspace. In the second approach, applicable only for office buildings, the average amount of floorspace per worker is used to estimate the number of workers per unit of floorspace and then peak hour factors derived from transportation facility counts are used to determine the share of those worker traveling in the peak hour.

In Approach 1 using pedestrian counts, trip generation estimates are made for offices, residential buildings, and retail and restaurant floorspace.

Office buildings:

- 15 trips in and out of buildings per 1000 square feet of floorspace or 7.5 trips in and 7.5 trips out (USFP, page 34).
- 29.8 % of all inbound trips during morning peak hour and 31.2 % of all outbound trips during evening peak hour (average of two office building counts as reported in USFP, page 40).
- Each 1 million square feet of office space generates in morning peak hour 1000 x 7.5 x 0.298 trips = 2,235 trips into building
- Each 1 million square feet of office space generates in evening peak hour 1000 x 7.5 x 0.312 = 2,340 trips from building.

Residential buildings:

- 7.8 trips in and out of Manhattan residential per dwelling (based on USFP, page 33)
- 16 % of outbound trips in morning peak hour; 18 % of all inbound trips in evening peak hour (derived from USFP, page 37)
- Each 1000 dwelling units generates 7.8 x 0.5 x 1000 x 0.16 = 624 trips out during morning peak hour
- Each 1000 dwelling units generates 7.8 x 0.5 x 1000 x 0.18 = 702 trips in during evening peak hour

Retail Establishments:

- 300 trips in and out of Manhattan retail establishments per 1,000 square feet of retail space (types of retail uses vary widely, based on weekday average of five counts at Manhattan stores, USFP, page 35)
- 23.8 % in and out trips in midday peak hour (derived from USFP, page 40)
- 18 % of inbound trips in evening peak hour (derived from USFP, page 40)
- Each 10,000 square feet of retail floorspace generates 300 x 10 x 0.238 = 714 trips into and out of stores during midday peak hour
- Each 10,000 square feet of retail floorspace generates 300 x 0.5 x 10 x 0.18 = 270 trips into stores during evening peak hour

Restaurants:

- 315 trips in and out of Manhattan retail establishments per 1,000 square feet of retail space (types of restaurants vary widely, based on weighted average of three counts at Manhattan restaurants, USFP, page 34)
- 19 % of in and out trips in midday peak hour (derived from USFP, page 40)
- 12.8 % of in and out trips in evening peak hour (derived from USFP, page 40)
- Each 10,000 square feet of restaurant floorspace generates 315 x 10 x 0.19 = 599 trips into and out of restaurants during midday peak hour
- Each 10,000 square feet of restaurant floorspace generates 315 x 10 x 0.128 = 403 trips into and out of restaurants during evening peak hour

Approach 2:

- Office space per worker = 250 square feet
- 90 % is share of workers at traveling to work on a given day
- Each million square feet produces 4,000 workers
- Maximum peak hour % based on

counts at public transit facilities oriented to work trips = 53.0 % (based on averages from 2000 Hub-bound counts at 3 commuter rail facilities and downtown PATH); use higher % of 58 % to account for small share of non-work trips

• Each million square feet of office floorspace in morning peak hour generates 1000/250 x 0.90 x 0.58 = 2,088 trips

In this second approach the evening peak hour is not estimated, since the counts include many persons not traveling for work purposes.

Recapping, the estimates for office building peak period trips using the two approaches are similar. In approach 1, 2,235 trips per million square feet in morning peak hour are estimated, in approach 2, 2,088 trips per million square feet. Approach 1 produces 2,350 trips per million square feet for the evening peak. Thus, in this report there is a high level of comfort in using either of these, or and average of both. Also, there is an increased level of comfort using the trip rates for the other uses, residential, retail and restaurant developed in Approach 1. Thus, the following trip generates will be used in the report:

OFFICES
- morning peak hour 2,150 per 1 msf
- evening peak hour – 2,350 per 1 msf

RESIDENTIAL
- morning peak hour – 625 per 1,000 units
- evening peak hour – 700 per 1,000 units

Retail and Restaurant Trip Generation Rates (for information and potential future use)
RETAIL
- midday peak hour (two-way) - 700 per 10,000 square feet
- evening peak hour (two-way) - 270 per 10,000 square feet

RESTAURANT
- midday peak hour – 600 per 10,000 square feet
- evening peak hour – 400 per 10,000 square feet

{references}

1. See RPA's report, *The Far West Side and the Region's Future Development Needs,* for a fuller background regarding the economic prospects for the Far West Side.

2. This problem is an extremely serious one that will hamper the NY region and other places in the nation in their analyses of transportation projects. While not the focus here, appropriate agencies in the Region must combine efforts to overcome this problem.

3. Urban Space for Pedestrians, by Pushkarev and Zupan, MIT Press, 1975. This book will be referred to as USFP in this report.

4. The concept of "short stubby" models as being preferred to long stringy ones was first raised by William Alonso in his seminal paper, " Predicting Best with Imperfect Data", Journal of the American Institute of Planners, July 1968.

5. As discussed earlier, the US Census has failed us in spectacular fashion and by all indications the 2000 data for work travel will never be of sufficient quality nor in enough detail to be fully usable for transportation planning purposes.

6. For example, the rail shares were increased in Morris and Essex counties in New Jersey, accounting for the initiation of direct rail service to Penn Station in the mid-1990s.

7. For example, to determine data on office generated trips in the evening peak for Scenario 4 for 2035, refer to Table 2, which shows the number of trips generated as 49,350, or 4.92 times the number generated under Scenario 1 in 2015 in the morning peak, the situation detailed in Table 4. By using Table 4 and the appropriate ratio, modal and origin numbers can be derived. For example, the additional number of people traveling to work by auto from NYC under Scenario 4 in 2035 would be 905 x 4.92 = 4,453.

8. The comfortable standard is 5.4 square feet, recommended in Urban Rail in America by Pushkarev et al, 1980, Indiana University Press. This produces a recommended volume of 23,333, based on operation of 28, 10-car IRT sized cars.

9. The same exercise regarding the impact of transferees at Times Square was not carried out for this report. The corridors at that station are less easily analyzed and while the station is extremely busy, it is not as confining as Grand Central. Nevertheless, a similar exercise is worth considering there.

10. Pedestrian counts were taken in five minute intervals up and down each stairway and escalator from 7:35 a.m. to 9:00 a.m. on June 19, 2003 by RPA personnel.

11. This project would only serve Metro North's Hudson and New Haven lines. New Haven line operation would require the completion of the LIRR East Side Access project to free capacity under the East River for New Haven line trains using the Hell Gate Bridge.

12. Because it is not feasible to operate Metro North's Harlem Line into Penn Station, riders on that line would not be diverted. The make up about one-third of Metro North's ridership.

13. See "The Case for a New Hudson River Passenger Rail Tunnel" on RPA's website, www.rpa.org.

14. The effect of this assumption would be a slight lowering of the volumes using the Flushing line by about nine percent since fewer workers would be residing in areas served by the Flushing line.

15. Under the more aggressive housing and office scenarios this percent could climb higher; adjusting this assumption upward would have some effect on the trips made by transit, but would not materially alter the conclusions reached here.

16. By way of example, fifteen of the 22 hotels being used in Midtown by the Republican National Convention this coming summer would be within 1,000 feet of this light rail route.

17. New York City and the MTA are cooperating on a study to test this concept, intended to lead to five bus rapid transit projects over the next 18 months.

18. The strong reliance on this book, published in 1975, requires some explanation. When published it represented the first comprehensive look at travel in urban areas that accounted fully for trips made on foot, using data collected in Midtown Manhattan for the bases of its analyses. More current literature is somewhat more cognizant of this formerly missing component of urban travel, yet there remains no work that accounts for pedestrians as completely. It had the further advantage of collecting data in Midtown Manhattan, the same venue as this report. Some may wonder whether the relationships developed in Urban Space for Pedestrians survive the passage of 30 years. Without replication of the earlier work that question cannot be definitively answered, but it is the opinion of this writer that little has changed, certainly not enough to warrant any rejection of the assumptions used here.

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